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Province-Wide Prevalence Testing for SARS-CoV-2 of In-Center Hemodialysis Patients and Staff in Ontario, Canada: A Cross-Sectional Study

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Abstract

Background: People receiving in-center hemodialysis face a high risk for contracting severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and experience poor outcomes. During the first wave of the coronavirus disease 2019 (COVID-19) pandemic in Ontario (between March and June 2020), it was unclear whether asymptomatic or presymptomatic cases were common and whether widespread testing of all dialysis patients and staff would identify cases earlier and prevent transmission. Ontario has a population of about 14.5 million. Approximately 8900 people receive dialysis across 102 in-center dialysis units.

Objective: The objective of this study was to determine participation rates for patients and staff in point prevalence testing in dialysis units across the province and to determine the prevalence of asymptomatic or presymptomatic infection.

Design: Cross-sectional study design.

Setting: In-center hemodialysis units at 27 renal programs across Ontario.

Participants: Patients and staff in in-center dialysis units in Ontario.

Measurements: Participation rates, demographic data, SARS-CoV-2 positivity rates, and COVID-19-related symptom data.

Methods: From June 8 to 30, 2020, all in-center dialysis patients and staff in the Province of Ontario were requested to undergo a symptom screening assessment and nasopharyngeal swab. Testing was done using polymerase chain reaction to detect SARS-CoV-2. A standardized questionnaire of atypical and typical COVID-19-related symptoms was administered to patients, to assess for new or worsening COVID-19-related symptoms.

Results: Patient participation was 83% (7155 of 8612) of which 15 tests were positive: less than 5 ($<$0.07%) were new positive cases, 7 were false positive, and the remaining were recovered positives. Half of the new positive cases had symptoms. Common symptoms reported included fatigue (4%), falls (4%), runny nose (3%), dyspnea (3%), and cough (3%). Staff participation was 49% (2109 of 4325), and less than 5 ($<$0.24%) were asymptomatic positive.

Limitations: As point prevalence testing was voluntary, not all patients and staff participated. Lower participation rate may be due to decreasing new cases in Ontario, and testing or pandemic fatigue, among other factors. This study did not use serology to identify prior infections because it was not widely available in Ontario. With respect to the standardized symptom questionnaire, it was only available in English and French and could not be tested due to the urgency of the initiative.

Conclusions: Participation among patients in point prevalence testing was good, but participation among staff was relatively low. Asymptomatic positivity in the dialysis patient and staff population was rare during the first wave of the COVID-19 pandemic in Ontario.

Keywords

COVID-19, renal dialysis, kidney failure, chronic population surveillance

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Introduction

Coronavirus Disease 2019 (COVID-19), the disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), first emerged in late 2019 in Wuhan, China, and has since spread rapidly around the world.[1,2]

People with kidney failure who receive in-center hemodialysis (HD) treatments are at increased risk for contracting the virus and experience high morbidity and mortality if they do.[3,4] Evidence suggests that patients receiving dialysis who have contracted the virus tend to have poor outcomes including hospitalization, intensive care unit admissions, need for mechanical ventilation, and death, compared with people in the general population with COVID-19.[3,5-7]

In-center HD patients are less able to self-isolate due to frequent travel to and from dialysis treatments and potential exposure when receiving treatment in a congregate setting.[5,8] In-center HD patients also tend to be older, frailer, have more comorbidities, are immunocompromised, and many live in congregate settings such as long-term care and retirement homes.[5,9,10]

In the province of Ontario, Canada, the first case of COVID-19 in a patient receiving in-center HD was detected in mid-March 2020. As of June 4, a total of 145 confirmed COVID-19 cases had been reported among chronic dialysis patients in Ontario. These cases equated to 1.6% of the dialysis patient population within Ontario. Of those patients who were infected, 26% (37 of 145) had died.[11]

During the first wave of COVID-19 in Ontario (between March and June 2020), HD units across the province employed various measures to prevent and control infections, including regular symptom screening, testing symptomatic patients, use of personal protective equipment, and cohorting or isolating suspected or known cases. In addition, some facilities had undertaken point prevalence testing of all patients and/or staff during an outbreak.[12]

At the time of the study, there were reported cases in Ontario of asymptomatic transmission in patients and staff.[13,14] For example, dialysis centers reported 21% to 55% of positive patients being asymptomatic at the time of detection.[15,16]

As part of a broader provincial strategy to identify and contain outbreaks in prioritized populations,[17] the Ontario Renal Network (ORN) coordinated a province-wide point prevalence testing program for all HD dialysis patients and the staff.

The purpose of this study was (1) to determine participation rates for patients and staff in point prevalence testing in dialysis units across the province, (2) to determine the prevalence of asymptomatic SARS-CoV-2 infection, and (3) to conduct a standardized questionnaire of atypical and typical COVID-19-related symptoms with dialysis patients.

Methods

Study Design

The ORN conducted a cross-sectional study in Ontario HD units between June 8 and 30, 2020, to estimate the prevalence of asymptomatic SARS-CoV-2 infection.

Study Setting

The ORN, part of Ontario Health, advises the Ontario government on chronic kidney disease (CKD) and manages the delivery and funding of CKD services in the province. The network consists of 27 regional renal programs providing care for patients with advanced kidney disease. Together, the regional renal programs provide HD care in 94 units. In addition, there are 6 independent health facilities that provide dialysis in 8 units.

To implement the provincial surveillance campaign, a steering committee was formed including nephrologists, regional renal program directors, infectious disease experts, and ORN staff. Program directors were consulted on their learning experience from unit-wide testing of patients and/or staff. Infectious disease experts were consulted on the appropriate interpretation of lab test results.

In addition, planning and implementation work was undertaken at each of the facilities to seek buy-in and approval for the surveillance initiative and ensure resources including human resources, personal protective equipment, and testing kits were available.

To support the facilities, the ORN created and shared resource materials. First, to help gain support at an executive level, the CEO of Ontario Health circulated a memo to all facilities involved stating the importance of the initiative and his support. The ORN produced an informational package that included the purpose and rationale of the initiative; information on implementation including standard inclusion and exclusion criteria, a standard symptom questionnaire and data collection requirements; and a list of considerations for

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facilities to support their planning and implementation. The standard symptom questionnaire was adapted based on provincial guidelines for typical and atypical symptoms of COVID-19 and was similar to screening questions that patients were already being asked.

The ORN prepared informational sheets to inform patients and staff of the purpose of the initiative prior to agreeing to participate. Finally, in consultation with infectious disease experts, a "primer" on asymptomatic positive patients was provided, containing information on the different scenarios that would result in an asymptomatic positive case, and how to confirm whether the patient is an asymptomatic positive, presymptomatic, or false positive case.

Participants

Patients and staff must have been at least 18 years of age and verbally agreed to testing to be included. All patients and staff, including those who had previously tested positive for SARS-CoV-2, were approached for point prevalence testing. Detailed inclusion and exclusion criteria for patients and staff are provided in Online Appendix B.

This point prevalence surveillance initiative comprised approximately 8900 patients receiving treatment in outpatient HD units in Ontario during the time period. It also included approximately 4300 dialysis unit staff members. Eligible staff included nurses, nephrologists, allied health professionals, environmental service staff, hospital transportation staff, and any staff who interacted with the unit during the testing time frame. Patients and staff from 102 dialysis units participated.

To have a consistent measure of COVID-19-related symptoms, all patients who were tested were asked to complete a standardized symptom questionnaire administered by the nurse (Online Appendix C). The questionnaire assessed the patient's ability to reliably answer the screening questions (based on willingness to participate, language barrier, and cognitive ability) and the presence of any of the 18 listed typical and atypical COVID-19 symptoms that were new or worsening. The questionnaire was only available in English or French.

Nasopharyngeal swabs (NPS) were collected and sent to local hospital or public health laboratories for testing using polymerase chain reaction (PCR) to detect SARS-CoV-2. Specific testing platforms varied by laboratory. Positive tests were classified as true positive and false positives. True positives were further classified as (1) newly identified positive, (2) recovered positive with persistent PCR positivity, or (3) presymptomatic or asymptomatic infection. Strategies to identify false positives among asymptomatic individuals included re-testing the original swab and re-swabbing the individual up to 2 more times between 24 and 48 hours apart.

Variables

For patients, record-level data were collected including the patient's name and health card number, whether the patient accepted or declined the swab, the date of the swab, the positive test result when applicable, and the results of the standardized symptom questionnaire. One participating program could only provide aggregate-level information (number of patients who accepted/declined the swab and the number of positive test results).

For staff, only data aggregated at the level of the HD unit were collected, including the number of staff in the dialysis unit, the number of staff swabbed, the number of staff who tested positive, and the start and end dates of testing. It was thought that collecting staff data at the aggregate level would improve participation rates as their personal health information would not be shared within and outside their organization. One participating program did not provide full staff testing data, thus was not included in this analysis.

If patients or staff were swabbed within the 7 days of the start of the surveillance period (ie, June 1-June 7, 2020), their test results were also included in the analysis.

For patients, demographic information including age and sex was identified by linking to the Ontario Renal Reporting System database. We estimated the proportion of tested patients who were symptomatic, calculated as patients presenting at least 1 of the 18 symptoms in the questionnaire (numerator) divided by the total number of tested patients (denominator). In addition, we estimated the proportion of tested patients who could reliably answer the symptom questionnaire, calculated as patients whose nurse recorded "Yes" for the question "Is the patient able and willing to reliably answer screening questions?" (numerator) divided by the total number of tested patients (denominator). The most common reasons for not being able to answer reliably were identified.

Participation rates for prevalence testing among patients and staff were calculated as the number of patients and staff who accepted the swab (numerator) divided by the number of patients and staff who accepted or declined the swab (denominator).

Statistical Methods

The proportion of patients and staff who tested positive for SARS-CoV-2 was estimated. The positive cases were reviewed by trained staff from the dialysis unit, infection prevention and control, and laboratory to determine whether they were true or false positives. True positives were classified as newly detected positive cases or patients who had prior SARS-CoV-2 infection who continued to test positive beyond the 14-day window of the first positive test (identified as "previously positive") based on a review of their prior results. The symptom questionnaire and clinical information was reviewed to determine whether newly detected positives were asymptomatic, presymptomatic, or symptomatic.

All analyses were conducted using R version 4.0.2. Results when the patient or staff number in any category was 5 or less were presented as being "5 or less" rather than as the

Table 1. Sex and Age Information Among Tested Patients in Ontario.

Demographic variable	Number of patients (%)
Sex	
Male	4177 (60)
Female	2729 (39)
Unknown	63 (0.9)
Age	
19-29	78 (1)
30-39	205 (3)
40-49	437 (6)
50-59	1043 (15)
60-69	1628 (23)
70-79	2064 (30)
80-89	1270 (18)
90+	186 (3)
Unknown	58 (0.8)
Median (IQR)	70.0 (59-78)

Note. IQR = interquartile range.

actual number due to privacy agreements at Ontario Health (Online Appendix A).

Results

Demographic Information and Participation Rates

Across Ontario, 7155 of 8612 patients (83%) agreed to be tested for surveillance purposes. The participation rate ranged from 56.1% to 100% between regional renal programs and independent health facilities.

Among the 6969 tested patients where record level data was available, 4177 (60%) patients were male. The majority of patients tested (74%) were aged 60 and older, with a median age of 70.0 years (interquartile range [IQR]: 59-78) (Table 1).

Within the facilities that submitted data, 2109 of 4325 staff (49%) agreed to surveillance testing. The participation rate ranged from 8% to 100%.

Standardized Symptom Questionnaire

A total of 6649 tested patients completed the standardized symptom questionnaire; 6247 (94%) were considered to be able to answer the symptom questionnaires reliably and 1034 (17%) patients were considered symptomatic. Among the 402 patients who could not answer reliably, the most common reasons were language barrier (49%), willingness to participate (28%), and cognitive impairment (22%) (Table 2).

The 5 most commonly reported new or worsening symptoms among patients were fatigue or body aches (4% of 6969 patients tested), unsteady gait or recent falls (4%), runny nose or sneezing (3%), difficulty breathing or shortness of breath (3%), and cough (3%). Symptoms documented were based on what the patient reported and what was observed by the nurse during the administration of the standardized symptom questionnaire and only considered new or worsening symptoms. Detailed results can be found in Table 3.

Table 2. Most Common Reasons Among Tested Patients for Not Being Able to Answer Symptom Questions Reliably in Ontario.

Reason	Count	% among all tested patients who could not answer reliably (n = 402)
Language barrier	196	49
Willingness to participate	112	28
Cognitive impairment	88	22
Acute mental illness	10	3

SARS-CoV-2 Positivity Rates

Of the 7155 patients tested, only 15 positive results were identified. Of these cases, 8 were determined to be true positive cases (positivity rate 0.1%). Among the 8 true positive cases, less than 5 were considered newly detected positive cases, the remaining were resolved infections that continued to test positive (case numbers below 5 cannot be reported for privacy reasons). Of those newly detected positive cases, half showed symptoms including cough, sore throat, hoarse voice, and fatigue/body aches. The remaining 7 positive results were determined to be false positive (Figure 1).

For staff, less than 5 positive test results were identified out of 2109 staff tested (positivity rate <0.2%), all of which were determined to be newly detected positive cases and asymptomatic (Figure 2).

Discussion

Asymptomatic newly detected infections were rare among patients and positive tests were more likely to be from patients with resolved infections or false positives. In retrospect, this study was conducted at a time when prevalence of infection was falling, which likely explained why detection of new infections was low. Over the course of June 2020, 7-day case averages declined from about 300 to about 150 by the end of the month.

Symptoms that could indicate a SARS-CoV-2 infection were common and although not all patients could reliably answer screening questions, asymptomatic testing did not identify a significant number of cases beyond symptom-based screening. This result highlights the challenges of screening HD patients during the COVID-19 pandemic, which is relevant for future surveillance with HD units.

At the time of this study, there had been 145 infections in the chronic dialysis population (1.6%) which was nearly 8 times the cumulative rate in the community (0.21%).[11] The

Table 3. Most Common Symptoms Among Tested Patients in Ontario.

Symptom	Count	% among all tested patients (n = 6969)[a]
Fatigue or body aches	277	4
Unsteady gait or recent falls	274	4
Runny nose or sneezing	237	3
Difficulty breathing or shortness of breath	235	3
Cough	222	3
Burning, dry, or itchy eyes with or without discharge or crusting	188	3
Diarrhea	124	2
Nasal congestion	113	2
Headache	103	2
Nausea	96	1
Hoarse voice	86	1
Abdominal pain	74	1
Confusion	57	0.8
Vomiting	52	0.7
Difficulty swallowing	47	0.7
Loss of taste or smell	47	0.7
Sore throat	34	0.5
Fever or chills	22	0.3

[a]As the sample size is the same, percentage of patients with each symptom are accurate within ±2%.

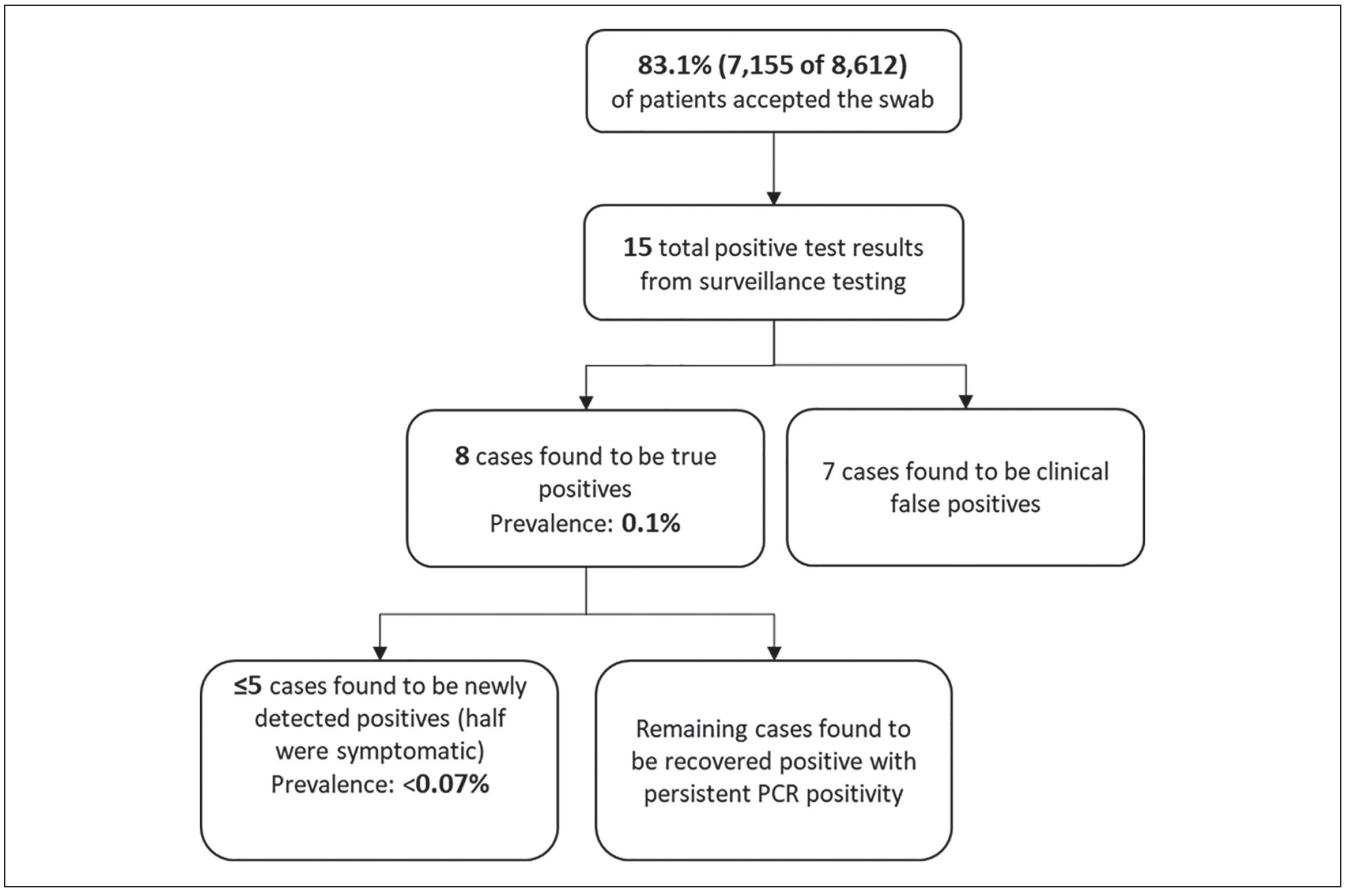

Figure 1. Surveillance testing of in-center dialysis patients aged ≥18 years in Ontario (based on 27 Regional Renal Programs and 6 Independent Health Facilities).
Note. Results with patient count of 5 or below were masked due to privacy agreements at Ontario Health. PCR = polymerase chain reaction.

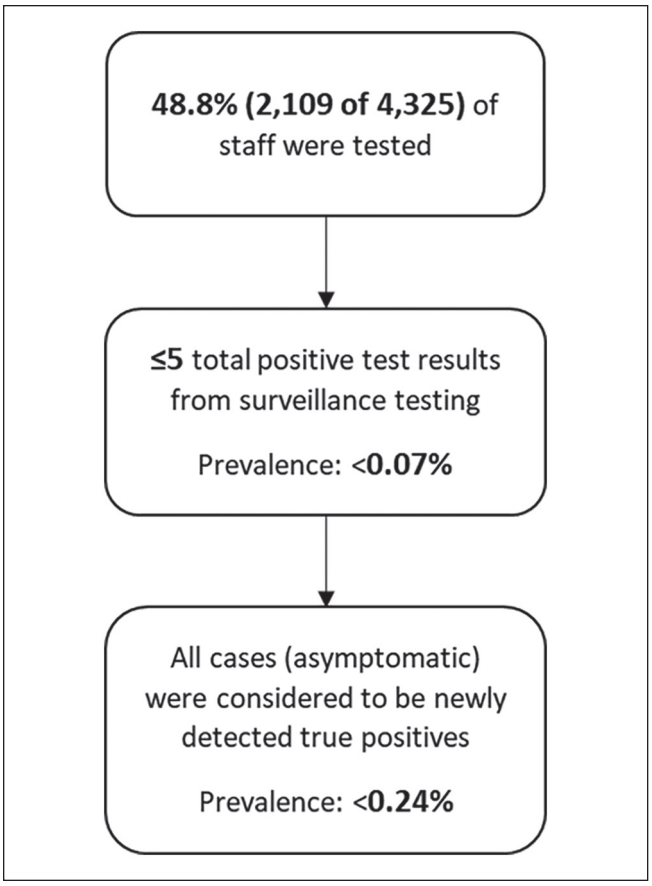

Figure 2. Surveillance testing of in-center dialysis unit staff aged ≥18 years in Ontario (based on 26 Regional Renal Programs and 6 Independent Health Facilities).
Note. Results with staff counts of 5 or below were masked due to privacy agreements at Ontario Health.

high infection rate in the chronic dialysis population may be related to frequent travel to and from dialysis treatments, potential exposure when receiving treatment in a congregate setting despite strict infection control practices, but also increased likelihood of being tested. This patient population may also have higher risk factors for exposure in the community, such as lower socioeconomic status. There had been outbreaks in renal programs in Ontario[15] and considerable concern about asymptomatic carriage. The results of this provincial study were very reassuring as the rate of asymptomatic carriage was not known at the time of this study and could have been conceivably higher. The reassuring results are in part a measure of success for the efforts dialysis programs put in place during the COVID-19 pandemic,[12] but also due to the timing of the testing, because the burden of COVID-19 in the community was lower during this time.

Results are similar to a study from Hamilton, Ontario, Canada, of 125 asymptomatic inpatients at 4 acute care hospitals which showed that, during a period of low community prevalence (daily new case rate of 1.9 per 100 000), asymptomatic cases were rare (0.8% positivity rate).[18] Another point prevalence study of 104 chronic dialysis patients in Halifax, Nova Scotia, Canada, came to similar conclusions.[19] However, other studies from Yau et al and Clarke et al found asymptomatic cases were more prevalent, so the true burden of disease in the population was not known.[15,16] These results were from studies conducted in a single dialysis unit, often close to the time of an outbreak, which could increase asymptomatic cases. Yau et al included PCR testing, while Clarke et al included both PCR and serology testing.[15,16]

Our results support the conclusion that the value to province-wide point prevalence testing for SARS-CoV-2 conducted depends on the degree of community transmission, whether strict infection controls are in place and whether patients tend to report symptoms when infected.[18] Recent reports have found asymptomatic infections are common in the general and dialysis population but they are not actively screened for symptoms like dialysis patients.[7,14-16,20]

Our findings highlight the challenges of symptom screening in the chronic dialysis population. Previous studies of dialysis patients found those with SARS-CoV-2 infections presented with fever, cough, fatigue, dyspnea, and gastrointestinal issues.[21-24] We used a common screening questionnaire and found not all patients could answer questions reliably. Among those that could answer reliably, symptoms such as fatigue or body aches, unsteady gait or recent falls, runny nose or sneezing, difficulty breathing or shortness of breath, and cough were common. This high background burden of symptoms in this patient population, as reported in other studies,[25] can make it difficult to detect new COVID-19-related symptoms.

Limitations

Due to the nature of universal point prevalence surveillance, a few limitations should be considered.

First, not all patients and staff participated because it was voluntary. The lower participation rate may be because the number of new cases in Ontario was decreasing. This may have limited the number of patients and staff who were willing to participate as their perceived risk of contracting the disease may have been low or they did not experience symptoms. In addition, some patients and staff were likely experiencing testing or pandemic fatigue after months of regular testing and precautions being in place. Some programs already had unit-wide surveillance of their patients and staff. Participation among staff was relatively low. Staff may have been reluctant to undergo testing for fear of stigma or that a positive result would require mandatory quarantine and potentially lost income. The initiative was also being implemented by a provincial body, rather than their employer. Perhaps a future strategy could be to work more closely with occupational health departments to increase testing rates. Stronger engagement of staff is needed to better understand reluctance of being tested. Another limitation was that this study did not use

serology to identify prior infections because it was not widely available in Ontario. Moreover, the focus of this study was on current infection rates; thus, the use of PCR testing was deemed appropriate. With respect to the standardized symptom questionnaire, it was only available in English and French, though we reported on patients who could not reliably answer due to a language barrier. The questionnaire was not tested due to the urgency of the initiative. There may have been misclassification bias due to the high prevalence of baseline symptoms in our patient population. However, the questionnaire was aimed to standardize how symptoms were identified across all centers.

Conclusions

Participation among patients in point prevalence testing was good, but participation among staff was relatively low. We confirm asymptomatic infection was rare in the first wave of the COVID-19 pandemic in Ontario, Canada. The utility of widespread surveillance depends on the community prevalence, whether strict infection control procedures are in place and whether patients with infection are likely to display symptoms.

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Ethics Approval and Consent to Participate

The ORN is designated as a prescribed entity under the *Personal Health Information Protection Act, 2004* and is permitted to collect personal health information without consent for the use of planning, management, and analysis of the health system. See Online Appendix A for details.

Consent for Publication

All authors have provided consent for publication.

Availability of Data and Materials

Ontario Health is prohibited from making the data used in this research publicly accessible if they include potentially identifiable personal health information and/or personal information as defined in Ontario law, specifically the *Personal Health Information Protection Act* and the *Freedom of Information and Protection of Privacy Act*. Upon request, data de-identified to a level suitable for public release may be provided.

Declaration of Conflicting Interests

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Supplemental Material

Supplemental material for this article is available online.

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